

# Analysis of big data push and Nash Equilibrium: a case study of live commerce on TikTok

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**Abstract.** In this growing field of digital marketing, integrating big data strategy and modern commerce has become a revolutionary sales method. The goal of this article is to explore the profound connection between big data push strategies and Nash equilibrium in modern business. Taking the TikTok as an example, I will analyze how big data push is used to influence consumers' shopping decisions. The article will also explore how this effect reflects the Nash equilibrium principle in game theory. Based on these goals, this study examines in detail how to collect, process and analyze user information on the data platform to create accurate user portraits. The platform can perform targeted push based on user portraits to attract consumers who are most likely to purchase the pushed products. The importance of this study is that it analyzes the combination of big data-driven marketing strategies and game theory concepts to gain a deep understanding of the key role of big data in shaping consumer behavior, as well as the practical application of game theory in current Internet commerce. , filling the gap in the academic field in the field of cooperation between classic economic models and modern marketing, and has far-reaching significance for modern economics research.

## 1 Introduction

In the rapidly developing field of digital sales, the combination of big data analysis and real-time commerce has become a revolutionary marketing method, widely used by platforms like TikTok. The use of big data can not only be applied as a new approach of advertising and promotion, but also influence the shopping decisions and behaviors of consumers on the platform by analyzing consumer data, ultimately increasing consumers' enthusiasm for shopping on the platform and increasing consumers' "brand loyalty" to the platform. This behavior can be viewed as the platform's analysis of consumer behavior in order to form a strategy that the best responds to consumer actions. Therefore, it can be regarded as the mature application of Nash equilibrium in the field of modern marketing. This represents the application of Nash equilibrium in the field of digital marketing. This article will take TikTok as an example to provide a comprehensive analysis of the application of Nash equilibrium in the live streaming industry. Through this research, I aim to gain a better understanding of the significant impact of big data on consumer behavior, the role of game theory in business during the Internet era, and the potential risks associated with personalized big data push for society and consumers.

## 2 Situation of live streaming

"Live" appeared on November 2, 1936 as a television program [1]. Its real rise as a business model began during the epidemic, when the contradiction between users' demand for shopping and the difficulty of going out to shop during the epidemic prompted e-commerce platforms such as TikTok to quickly become important business platforms in the Internet era. In recent years, despite the end of the COVID-19 epidemic, live streaming is still in a stage of rapid development and has become an important means for modern people to shop. Taking TikTok as an example, its diverse content, including big-name beauty, technology products to affordable food, cheap daily necessities, etc., has attracted all kinds of user groups, providing a broad potential customer base for live streaming, real-time feedback from anchors, and a model of direct interaction with consumers, which also increases the shopping experience of consumers. Most importantly, the platform is personalized through accurate big data. Successfully convert potential consumers into consumers.

Taking the performance of live streaming in China as an example, Taobao, the largest e-commerce platform, generated sales of 498.2 billion yuan during China's Double 11 shopping festival alone, of which TikTok, as a non-traditional e-commerce platform, has created a unique form of personalized push with big data and live streaming that is superior to other platforms. With sales of 100.9 billion RMB, it has gradually become one of the most important e-commerce platforms in China as a social platform [2]. Live streaming also provides a huge development opportunity for personal development.

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Since 2021, "Crazy Brother Yang" (Qingyang Zhang) has transformed from a short video expert to a streamer with goods, relying on the tens of millions of popularity accumulated by his funny short videos, and the platform to accurately push potential users among short video fans, and finally achieved great commercial achievements, and its annual sales in 2023 are estimated to reach 15 billion yuan. At the same time, TikTok's precise push to potential users on all platforms has also caused a crazy increase in the number of fans of "Crazy Brother Yang", as of now. The number of fans of the account has reached about 180 million, and the huge number of fans has formed a virtuous circle with the platform's precise big data push, which has promoted the expansion of its sales.

At the same time, live streaming contains certain potential risks. Since the relationship between the media is in a winner-takes-all mode in the information cocoon, all platforms will choose to push the best response to consumers in that time period to get the best benefit in the short term, which will lead to a situation similar to the "prisoner's dilemma", so that the "best response" is not the dominant strategy, in other words, not the best choice in the long term [3]. Big data personalized push is based on the behavior of each individual user on the platform to best respond to it. This means that the push to each individual user is almost similar, and the content of the best reply to the user will increase the user's shopping experience in the short term, and increase the likelihood that the user will make a short-term purchase. In the long run, an information cocoon will be formed, which not only limits the scope of users' information exposure, but also reduces the diversity of consumption, making the platform's business less dynamic, and more importantly, from the perspective of the long-term development of the platform, the information cocoon will gradually make users feel "bored" and exacerbate the risk of permanent loss of users. In addition, big data push has also promote the user's subjective preference, topic concern, and content expression of browsing content to show a homogenization trend, greatly affected the shopping experience of consumers [4].

### 3 Game theory and Nash equilibrium

Game theory, also affectionately known as strategy theory, is a nascent branch of modern mathematics and one of the most important elements in the field of operations research. Its primary research focus is on the interaction between different incentive mechanisms and the thorough analysis of the balanced response process. Game theory is committed to digging deep into complex phenomena, such as competition, and examines the strategies individuals should adopt to maximize benefits when responding to external environmental stimuli. Furthermore, this theory helps to interpret biological evolutionary processes and in predicting potential future

outcomes. Moreover, game theory has become an essential research tool in the field of economics. So far, this theory has been widely applied in various fields, including finance, securities, biology, economics, international relations, computer science, political science, and military strategy.

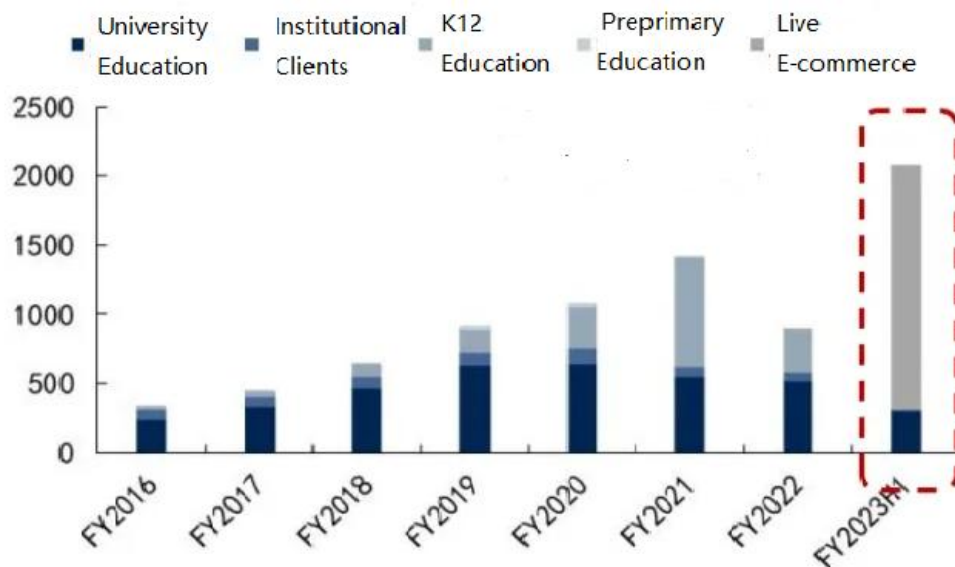
The Nash Equilibrium describes a combination of strategies in which all participants are in a state where they must maintain the original strategy in order to achieve maximum returns. On the other hand, if any participant attempts to change their strategy, it will immediately result in a corresponding decrease in their own returns. Therefore, every rational participant must strive to maintain a strong strategy and should not adjust their strategy lightly unless they encounter a very exceptional situation. The "equilibrium even" refers to a specific type of game environment. It assumes that Party A and Party B choose their optimal strategies  $A^*$  and  $B^*$  respectively. If Party A chooses  $B^*$  again and Party B encounters Party A's adjustment to the original strategy  $A$ , then the cumulative profit of the cache confession will exceed the situation when the two parties initially chose their strategies. Similarly, this rule also applies to Party B.

### 4 Case study – Take Oriental Selection as an example

"Oriental Selection" is a live streaming platform for agricultural products launched by New Oriental. Its parent company, New Oriental, was originally an educational institution, but after implementing the "double reduction" policy in China to reduce the burden of education, it announced its transformation on December 28, 2021, and established "Oriental Selection" to officially enter the live broadcast e-commerce industry on the TikTok platform. In June 2022, "Oriental Selection" became popular overnight with its unique live broadcast model, with 470,000 followers in one day and 19.5 million followers in a whole month, and 6 live broadcast accounts were opened, forming a live broadcast matrix [5].

The following chart shows the revenue of Oriental Selection's business from 2016 to 2023. Specific business areas include university education, middle and high school education (K12 education), nutritious catering and live streaming e-commerce.

As can be seen from Figure 1, although the revenue of each business has almost increased in different years, the growth of live broadcast e-commerce is the most significant. It can be said that the growth of live broadcast e-commerce is the driving force for the company's revenue growth. Especially during 2021 and 2022. Live streaming e-commerce's viewership in fiscal year 2022 appears to account for the largest share of all businesses.



**Figure 1.** Starting from fiscal year 2023, e-commerce business has become the main driving force for the company's growth (Picture credit: Original) (Data source: Company announcement, Guoxin Securities Economic Research Institute).

The part framed with a red dotted line on the right side of the chart predicts the revenue in fiscal year 2023. Although the specific figures are not shown, judging from the trend, live broadcast e-commerce is expected to have huge growth and be ahead of other business lines. . The text description at the bottom mentions that the data in the chart comes from company announcements and the Securities Research Institute, and the data is extremely reliable.

It is essential that live streaming is of great significance to New Oriental, accounting for an important part of the company's main revenue, and it still has huge room for growth. Therefore, Dongfang Selection can be used as a typical research case in this topic. Therefore, the analysis of the relationship between the big data push strategy used by "Dongfang Selection" in live streaming on the TikTok platform and the Nash equilibrium is not only helpful to understand the specific embodiment of game theory in the contemporary Internet economy, but also provides a profound example for the study of micro-economy, and has certain significance for further analyzing and summarizing the innovation of the live streaming model, and providing reference for the development of e-commerce using big data push.

The mode of live streaming is inseparable from the correlation of game theory. Under this business model, the application of big data provides in-depth insight into the market, as a profound practical manifestation of the theory of game theory: all players (such as sellers, platforms, buyers) formulate strategies based on the collected information to maximize their own interests. For example, sellers can analyze consumers' likes, favorites, and purchase behaviors through big data to understand their preferences and needs, so as to customize their promotion strategies to gain an advantage in the highly competitive market [6]. This kind of strategy development involves not only responding to current market conditions, but also

predicting future market trends after collecting and building massive data models. Game theory provides a theoretical support here, enabling all parties to find the best strategy point in the ever-changing market environment and achieve the optimal decision with different information at each stage. Through this approach, the live streaming model not only improves sales efficiency, but also provides participants with a way to compete and cooperate based on big data strategies. Under the framework of game theory, Dongfang Selection gives full play to personalized marketing by analyzing the big data model provided by the TikTok platform. Highlight Dong Yuhui's personal IP, create a diversified way of live content, shape the cultural experience of customers, and accurately penetrate the emotional and cultural needs of customers [5]. In the study from Liu, Zhao and Long, the excellent shaping of IP can effectively enhance the image positioning of the company and related products (goods or services) in the minds of consumers [7]. This personalized marketing method can be regarded as making the best response to customer needs at that moment under the framework of game theory, and can also ensure that in the subsequent push, the big data model will recommend it to the brand's potential customers, achieve mutual benefit and win-win results with consumers, and reach the Nash equilibrium point in that time period.

The dynamic relationship between competition and cooperation is particularly critical in the game theory analysis of the live streaming model, where the concept of Nash equilibrium provides a framework for understanding and predicting market behavior. Participants, whether sellers, buyers, or platforms, are seeking to maximize their own interests [8], and this pursuit involves not only competition with competitors, but also potential collaborations with other market participants. In this multi-party environment, each role needs to constantly evaluate and adjust their own

strategies in response to the actions of other actors. For example, when deciding on product pricing, promotion strategies, and live content, sellers must not only appeal to consumers, but also consider the likely reaction of competitors. In this case, reaching a Nash equilibrium means finding a state in which neither side will benefit more, whether it is an increase in inputs, a change in marketing strategies, or an adjustment in price. Through in-depth analysis of big data, participants are able to more accurately predict market trends and counterparty behavior, thus more effectively reaching or approaching this equilibrium state. In this process, the live streaming market has become more efficient and stable, and all participants have jointly promoted the development and progress of the entire market through continuous strategy adjustments and market feedback. Under the Nash equilibrium, Dongfang Selection seeks a win-win cooperation point with customers, and maintains personalized and pure content to ensure that it is specialized and non-generalized under the big data algorithm, so that the target customers who are really interested in New Oriental culture and Dongfang Selection can see it [9]. It not only reduces the cost of pushing (push fees and publicity fees for the platform), but also ensures that the entire market is more diversified and strives for long-term development by approaching the Nash equilibrium point.

The Nash equilibrium point is always changing, and it changes with the market and consumer Xi. This means that Dongfang Selection needs to constantly explore new Nash equilibrium points to respond to the changing market and make the best response. By analyzing the constantly updated data, seeking new market changes, and finding new Nash equilibrium points, this process is a dynamic and continuous game process. If the platform only pushes the previous "best response" to the user for a long time, the customer will quickly feel bored, which will not only make Dongfang Selection lose customers, but the platform will even permanently lose the user, so that all merchants on the platform will lose a potential customer. What's more serious, Fu worried about that the push of big data in the media age makes it easier for people to fall into the trap of consumerism, reducing the vitality of the market economy and damaging the long-term earnings of the company [10]. Therefore, in the future development, Dongfang Selection should not only give full play to its existing advantages, but also explore new consumption tendencies through the user data provided by the platform, make new responses to consumer preferences, and push it to the audience with changing tendencies through big data, which can not only expand its own customer base, but also consolidate the loyalty of user groups to the brand.

To sum up, the analysis of Dongfang Selection reflects the role of big data push in live streaming, the theoretical basis of Nash equilibrium in big data push, and the vivid practice of game theory in modern Internet business. Through the theoretical combination of big data push and game theory, merchants similar to Dongfang Selection can use big data push to accurately define target customers and transform their potential advantages into market competitive advantages.

## 5 Limitation

This research has certain limitations due to various reasons such as platform attributes and research direction. First of all, because the research direction is focused on the TikTok platform, it lacks the breadth of the entire live streaming field. Second, because big data analysis relies on obtaining large amounts of user data, data access to TikTok and other live streaming platforms may be restricted by privacy policies and commercial confidentiality. Due to the restrictions and protections of the privacy policy, it is difficult for researchers to obtain accurate data for deeper research. Moreover, TikTok's recommendation algorithm is not public, which further limits understanding and analysis of its inner workings. At the same time, there is no variable control in this study. Various factors (such as anchor popularity, product quality, private domain traffic management, fan activity, etc.) may affect sales and operations, making it difficult to evaluate the role of big data push alone.

## 6 Conclusion

In conclusion, this article takes TikTok as an example, discusses the basic attributes of live streaming in modern e-commerce, the important position of big data models in it, and discusses the theoretical foundation of game theory based on Nash equilibrium. Then, taking Dongfang Selection, a delivery company on TikTok, as a case, the application of Nash equilibrium in the field of big data personalized push in e-commerce is discussed, and its positive effects and potential risks are discussed. This article can broaden understanding of the relationship between modern e-commerce and economic theory, understand the strategy of marketing in the context of the modern Internet, and understand the positive significance of big data push for modern business.

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